

CLAIMS

1. A method for manufacturing a minute structure, comprising:

a step of forming an ionizing radiation

5 decomposing type positive type resist layer including a methyl isopropenyl ketone as a first positive type photosensitive material layer to be sensitized by an ionizing radiation of a first wavelength range;

a step of forming an ionizing radiation

10 decomposing type positive type resist layer including a photosensitive material of a copolymer obtained by the copolymerization of an ester methacrylate and a methacrylic acid, with the weight average molecular weight of the copolymer of 50,000 to 300,000 and the
15 ratio of the methacrylic acid included in the copolymer of 5 to 30% by weight as a second positive type photosensitive material layer to be sensitized by an ionizing radiation of a second wavelength range on the first positive type photosensitive material
20 layer;

a step of forming a desired pattern in the above-mentioned second positive type photosensitive material layer as the upper layer by decomposing reaction only in the desired area of the above-
25 mentioned second positive type photosensitive material layer without decomposing reaction of the

above-mentioned first positive type photosensitive material layer by directing an ionizing radiation of the above-mentioned second wavelength range via a mask to the substrate surface with the first and
5 second positive type photosensitive material layers formed, and development using a developing solution, and then;

a step of forming a desired pattern in the above-mentioned first positive type photosensitive material layer as the lower layer by decomposing
10 reaction of a predetermined area of at least the above-mentioned first positive type photosensitive material layer by direction an ionizing radiation of the above-mentioned first wavelength range via a mask
15 to the substrate surface with the first and second positive type photosensitive material layers formed, and development, successively;

characterized in that a pattern of a convex shape is manufactured in the substrate by executing
20 the above-mentioned steps.

2. A method for manufacturing a minute structure, comprising:

a step of forming an ionizing radiation decomposing type positive type resist layer including
25 a methyl isopropenyl ketone as a first positive type photosensitive material layer to be sensitized by an ionizing radiation of a first wavelength range;

a step of forming an ionizing radiation decomposing type positive type resist layer including a photosensitive material of a copolymer obtained by the copolymerization of an ester methacrylate and a methacrylic anhydride, with the weight average molecular weight of the copolymer of 10,000 to 100,000 and the ratio of the methacrylic anhydride included in the copolymer of 5 to 30% by weight as a second positive type photosensitive material layer to be sensitized by an ionizing radiation of a second wavelength range on the first positive type photosensitive material layer;

a step of forming a desired pattern in the above-mentioned second positive type photosensitive material layer as the upper layer by decomposing reaction only in the desired area of the above-mentioned second positive type photosensitive material layer without decomposing reaction of the above-mentioned first positive type photosensitive material layer by directing an ionizing radiation of the above-mentioned second wavelength range via a mask to the substrate surface with the first and second positive type photosensitive material layers formed, and development using a developing solution, and then;

a step of forming a desired pattern in the above-mentioned first positive type photosensitive

material layer as the lower layer by decomposing
reaction of a predetermined area of at least the
above-mentioned first positive type photosensitive
material layer by direction an ionizing radiation of
5 the above-mentioned first wavelength range via a mask
to the substrate surface with the first and second
positive type photosensitive material layers formed,
and development, successively;

characterized in that a pattern of a convex
10 shape is manufactured in the substrate by executing
the above-mentioned steps.

3. The method for manufacturing a minute
structure according to claim 1 or 2, wherein the
first positive type photosensitive material layer is
15 obtained by forming a first positive type
photosensitive material layer by a solvent coating
method, vaporizing the coating solvent in the layer
by heating, coating a material for forming the second
positive type photosensitive material layer, and
20 vaporizing the coating solvent by applying the heat
to the formed coating layer.

4. A method for manufacturing a liquid
discharge head comprising a step of forming a mold
pattern with a removable resin in a liquid flow path
25 forming portion on a substrate with a liquid
discharge energy generating element formed, applying
and hardening a coating resin layer on the above-

mentioned substrate so as to coat the mold pattern,
and dissolving and removing the above-mentioned mold
pattern so as to form a liquid flow pat,
characterized in that the above-mentioned step of
5 forming a mold pattern comprises:

a step of forming an ionizing radiation
decomposing type positive type resist layer including
a methyl isopropenyl ketone as the first positive
type photosensitive material layer to be sensitized
10 by an ionizing radiation beam of the first wavelength
range on the substrate;

a step of forming an ionizing radiation
decomposing type positive type resist layer including
a photosensitive material of a copolymer obtained by
15 the copolymerization of an ester methacrylate and a
methacrylic acid, with the weight average molecular
weight of the copolymer of 50,000 to 300,000 and the
ratio of the methacrylic acid included in the
copolymer of 5 to 30% by weight as a second positive
20 type photosensitive material layer to be sensitized
by an ionizing radiation of a second wavelength range
on the first positive type photosensitive material
layer;

a step of forming a desired pattern in the
25 above-mentioned second positive type photosensitive
material layer as the upper layer by decomposing
reaction only in the desired area of the above-

mentioned second positive type photosensitive material layer without decomposing reaction of the above-mentioned first positive type photosensitive material layer by directing an ionizing radiation of the above-mentioned second wavelength range via a mask to the substrate surface with the first and second positive type photosensitive material layers formed, and development using a developing solution; and

10 a step of forming a desired pattern in the above-mentioned first positive type photosensitive material layer as the lower layer by decomposing reaction of a predetermined area of at least the above-mentioned first positive type photosensitive material layer by direction an ionizing radiation of the above-mentioned first wavelength range via a mask to the substrate surface with the first and second positive type photosensitive material layers formed, and development, successively.

20 5. A method for manufacturing a liquid discharge head comprising a step of forming a mold pattern with a removable resin in a liquid flow path forming portion on a substrate with a liquid discharge energy generating element formed, applying and hardening a coating resin layer on the above-mentioned substrate so as to coat the mold pattern, and dissolving and removing the above-mentioned mold

pattern so as to form a liquid flow pat,
characterized in that the above-mentioned step of
forming a mold pattern comprises:

5 a step of forming an ionizing radiation
decomposing type positive type resist layer including
a methyl isopropenyl ketone as the first positive
type photosensitive material layer to be sensitized
by an ionizing radiation beam of the first wavelength
range on the substrate;

10 a step of forming an ionizing radiation
decomposing type positive type resist layer including
a photosensitive material of a copolymer obtained by
the copolymerization of an ester methacrylate and a
methacrylic anhydride, with the weight average
15 molecular weight of the copolymer of 10,000 to
100,000 and the ratio of the methacrylic anhydride
included in the copolymer of 5 to 30% by weight as a
second positive type photosensitive material layer to
be sensitized by an ionizing radiation of a second
20 wavelength range on the first positive type
photosensitive material layer;

a step of forming a desired pattern in the
above-mentioned second positive type photosensitive
material layer as the upper layer by decomposing
25 reaction only in the desired area of the above-
mentioned second positive type photosensitive
material layer without decomposing reaction of the

above-mentioned first positive type photosensitive material layer by directing an ionizing radiation of the above-mentioned second wavelength range via a mask to the substrate surface with the first and
5 second positive type photosensitive material layers formed, and development using a developing solution; and

a step of forming a desired pattern in the above-mentioned first positive type photosensitive material layer as the lower layer by decomposing
10 reaction of a predetermined area of at least the above-mentioned first positive type photosensitive material layer by direction an ionizing radiation of the above-mentioned first wavelength range via a mask
15 to the substrate surface with the first and second positive type photosensitive material layers formed, and development, successively.

6. A method for manufacturing a liquid discharge head comprising a step of forming a mold
20 pattern with a removable resin in a liquid flow path forming portion on a substrate with a liquid discharge energy generating element formed, applying and hardening a coating resin layer on the above-mentioned substrate so as to coat the mold pattern,
25 and dissolving and removing the above-mentioned mold pattern so as to form a liquid flow pat, characterized in comprising at least:

a step of forming an ionizing radiation decomposing type positive type resist layer including a methyl isopropenyl ketone as the first positive type photosensitive material layer to be sensitized
5 by an ionizing radiation beam of the first wavelength range on the substrate;

a step of forming an ionizing radiation decomposing type positive type resist layer including a photosensitive material of a copolymer obtained by
10 the copolymerization of an ester methacrylate and a methacrylic acid, with the weight average molecular weight of the copolymer of 50,000 to 300,000 and the ratio of the methacrylic acid included in the copolymer of 5 to 30% by weight as a second positive
15 type photosensitive material layer to be sensitized by an ionizing radiation of a second wavelength range on the first positive type photosensitive material layer;

a step of forming a desired pattern in the
20 above-mentioned second positive type photosensitive material layer as the upper layer by decomposing reaction only in the desired area of the above-mentioned second positive type photosensitive material layer without decomposing reaction of the
25 above-mentioned first positive type photosensitive material layer by directing an ionizing radiation of the above-mentioned second wavelength range via a

mask to the substrate surface with the first and second positive type photosensitive material layers formed, and development using a developing solution, a step of forming a desired pattern in the

5 above-mentioned first positive type photosensitive material layer as the lower layer by decomposing reaction of a predetermined area of at least the above-mentioned first positive type photosensitive material layer by direction an ionizing radiation of
10 the above-mentioned first wavelength range via a mask to the substrate surface with the first and second positive type photosensitive material layers formed, and development;

a step of forming a pattern including the
15 discharge port by applying a photosensitive coating resin film onto the first and second positive type photosensitive material layers with the above-mentioned desired pattern formed, exposing a pattern including a discharge opening communicating with the
20 above-mentioned liquid flow path, and development;

a step of decomposing the resin components in the pattern comprising the above-mentioned first and second positive type photosensitive material layers by directing an ionizing radiation beam of a
25 wavelength range for the decomposing reaction of both the above-mentioned first and second positive type photosensitive material layers via the above-

mentioned photosensitive coating resin film; and

a step of soaking the substrate after having the above-mentioned steps in a predetermined organic solvent for dissolving and removing the pattern

5 comprising the above-mentioned first and second positive type photosensitive material layers.

7. A method for manufacturing a liquid discharge head comprising a step of forming a mold pattern with a removable resin in a liquid flow path forming portion on a substrate with a liquid
10 discharge energy generating element formed, applying and hardening a coating resin layer on the above-mentioned substrate so as to coat the mold pattern, and dissolving and removing the above-mentioned mold
15 pattern so as to form a liquid flow pat, characterized in comprising at least:

a step of forming an ionizing radiation decomposing type positive type resist layer including a methyl isopropenyl ketone as the first positive
20 type photosensitive material layer to be sensitized by an ionizing radiation beam of the first wavelength range on the substrate;

a step of forming an ionizing radiation decomposing type positive type resist layer including
25 a photosensitive material of a copolymer obtained by the copolymerization of an ester methacrylate and a methacrylic anhydride, with the weight average

molecular weight of the copolymer of 10,000 to 100,000 and the ratio of the methacrylic anhydride included in the copolymer of 5 to 30% by weight as a second positive type photosensitive material layer to
5 be sensitized by an ionizing radiation of a second wavelength range on the first positive type photosensitive material layer;

a step of forming a desired pattern in the above-mentioned second positive type photosensitive
10 material layer as the upper layer by decomposing reaction only in the desired area of the above-mentioned second positive type photosensitive material layer without decomposing reaction of the above-mentioned first positive type photosensitive
15 material layer by directing an ionizing radiation of the above-mentioned second wavelength range via a mask to the substrate surface with the first and second positive type photosensitive material layers formed, and development using a developing solution;

20 a step of forming a desired pattern in the above-mentioned first positive type photosensitive material layer as the lower layer by decomposing reaction of a predetermined area of at least the above-mentioned first positive type photosensitive
25 material layer by direction an ionizing radiation of the above-mentioned first wavelength range via a mask to the substrate surface with the first and second

positive type photosensitive material layers formed,
and development;

a step of forming a pattern including the
discharge port by applying a photosensitive coating
5 resin film onto the first and second positive type
photosensitive material layers with the above-
mentioned desired pattern formed, exposing a pattern
including a discharge opening communicating with the
above-mentioned liquid flow path, and development;

10 a step of decomposing the resin components in
the pattern comprising the above-mentioned first and
second positive type photosensitive material layers
by directing an ionizing radiation beam of a
wavelength range for the decomposing reaction of both
15 the above-mentioned first and second positive type
photosensitive material layers via the above-
mentioned photosensitive coating resin film; and

a step of soaking the substrate after having
the above-mentioned steps in a predetermined organic
20 solvent for dissolving and removing the pattern
comprising the above-mentioned first and second
positive type photosensitive material layers.

8. The method for manufacturing a liquid
discharge head according to any of claims 4 to 7,
25 wherein the first positive type photosensitive
material layer is obtained by forming a first
positive type photosensitive material layer by a

solvent coating method, vaporizing the coating solvent in the layer by heating, coating a material for forming the second positive type photosensitive material layer, and vaporizing the coating solvent by
5 applying the heat to the formed coating layer.

9. The method for manufacturing a liquid discharge head according to any of claims 4 to 7, wherein the first wavelength range for sensitizing the first positive type photosensitive material layer
10 is a 270 nm to 350 nm range, and the second wavelength range for sensitizing the second positive type photosensitive material layer is a 230 nm to 260 nm range.

10. A liquid discharge head manufactured by the
15 method for manufacturing a liquid discharge head according to any of claims 4 to 9, wherein the height of the liquid flow path is provided relatively lower at a point adjacent to the bubble generating chamber on the liquid discharge energy generating element.

20 11. The liquid discharge head according to claim 10, wherein the cross-sectional shape of the bubble generating chamber on the liquid discharge energy generating element is a convex shape.